NASA/TM—2000–209891, Vol. 26

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and David E. Knapp, Editors

Volume 26

BOREAS HYD-4 Areal Snow Course Data

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July 2000

Available from:

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7121 Standard Drive
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Price Code: A17

National Technical Information Service
5285 Port Royal Road
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John R. Metcalfe, Barry E. Goodison, Anne Walker

Summary

The BOREAS HYD-4 team focused on collecting data during the 1994 winter field campaign (FFC-W) to improve the understanding of winter processes within the boreal forest. Knowledge of snow cover and its variability in the boreal forest is fundamental if BOREAS is to achieve its goals of understanding the processes and states involved in the exchange of energy and water. The development and validation of remote sensing algorithms will provide the means to extend the knowledge of these processes and states from the local to the regional scale. A specific thrust of the hydrology research is the development and validation of snow cover algorithms from airborne passive microwave measurements.

Airborne remote sensing data (gamma, passive microwave) were acquired along a series of flight lines established in the vicinity of the BOREAS study areas. Ground snow surveys were conducted along selected sections of these aircraft flight lines. These calibration segments were typically 10-20 km in length, and ground data were collected at 1- to 2-km intervals. The data are provided in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS HYD-04 Areal Snow Course Data

1.2 Data Set Introduction

These ground snow survey data were collected to calibrate gamma and passive microwave remote sensing data that were acquired in the BOReasl Ecosystem-Atmosphere Study (BOREAS) study areas. The data were collected during the BOREAS Focused Field Campaign-Winter (FFC-W) in 1994 and

cover 10-20 km lengths with measurements representing the snow conditions for 1- to 2-km intervals along those lengths. This data set should be used in conjunction with the Hydrology (HYD)-06 Airborne Gamma Ray Soil Moisture Data since these two data sets cover the same sites. Please consult the documentation for this HYD-06 data set for more information about the transects.

1.3 Objective/Purpose

These data were collected during the BOREAS FFC-W, which took place during the period 02-Feb-1994 to 18-Feb-1994. These data were collected to provide detailed spatial snow depth and snow water equivalent (SWE) measurements in the BOREAS study areas to validate airborne remote sensing techniques and to serve as the basis in algorithm development to determine SWE using passive microwave data. These data will also provide background information for other BOREAS hydrological and satellite remote sensing components.

1.4 Summary of Parameters

- flight line number
- location (latitude/longitude)
- average snow water
- SWE
- depth and density
- number of samples
- standard deviation of SWE and depth
- general land cover characteristics

1.5 Discussion

Ground snow survey data were collected along preselected calibration lines of the airborne snow survey flight line network. Along each calibration line, snowpack information was obtained at a series of equally spaced locations along the line (e.g., 1 or 2 km). A concerted effort was made to locate sampling points in vegetation of the type and approximate percentage cover representative of the calibration flight line. Up to three SWE and depth measurements plus 15 additional snow depth measurements were taken at each sampling location.

Data were collected along 15 calibration lines in the Southern Study Area (SSA), 3 lines in the Northern Study Area (NSA), and 5 lines along a transect between the two study areas. Each calibration line was subsequently subdivided into approximately equal length segments called bins. Each bin represents an area of similar vegetation, determined by detailed land cover analysis of the BOREAS land classification by HYD-04, which was then provided to HYD-06 for processing the airborne gamma data. All reference coordinates are taken from Global Positioning System (GPS) North American Datum of 1983 (NAD83) sampling point locations averaged to represent the approximate center of the calibration line or bin.

1.6 Related Data Sets

BOREAS HYD-03 Snow Depth Data
BOREAS HYD-03 Snow Pits Data
BOREAS HYD-03 Snow Temperature Data
BOREAS HYD-03 Snow Water Equivalent Data
BOREAS HYD-04 Standard Snow Course Data
BOREAS HYD-06 Aircraft Gamma Ray Soil Measurement Data
BOREAS HYD-06 Ground Measurements of Soil Moisture
BOREAS HYD-06 Moss/Humus Moisture Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Barry Goodison
Chief, Climate Processes and Earth Observation Division
Climate Research Branch

Anne Walker
Scientist
Climate Research Branch

2.2 Title of Investigation

Determination of Snow Cover Variations in the Boreal Forest Using Passive Microwave Radiometry

2.3 Contact Information

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3. Theory of Measurements

Snow sampling equipment consists of a graduated tube with a cutter fixed to its lower end to permit easy penetration of the snow and a spring balance (reading directly in water equivalent units) to weigh the tube and its contents. The density of the snow is calculated by dividing the SWE by the depth of the snow at the sample point. Additional snow depth measurements were made with a graduated stick or ruler.

4. Equipment

4.1 Sensor/Instrument Description

The large diameter Eastern Snow Conference (ESC)-30 metric snow sampler with a cutter area of 30 cm^2 was used to obtain SWE measurements. A complete description of this sampler along with plans, specifications, and an assessment of errors and accuracy can be found in Farnes et al., 1982. The ESC-30 sampler is the current standard sampler used by the Atmospheric Environment Service (AES) for shallow snowpack regions. The following is a complete list of equipment supplied to the surveyors:

- 1 ESC-30 snow sampler
- 1 spring balance for ESC-30
- 1 cradle
- 1 measuring stick/ruler (cm)
- field book or snow survey form
- pencil

4.1.1 Collection Environment

These data were collected under snow cover conditions at various sites in the SSA and NSA.

4.1.2 Source/Platform

Measurements were made at selected sites, predetermined from a fixed point at the start of the calibration line. Individual points were selected randomly in a circle extending approximately 50 m in from the edge of the forest. Ground irregularities (e.g., boulders, logs) were avoided.

4.1.3 Source/Platform Mission Objectives

The objective of collecting these data was to provide ground-based snow measurements coincident with airborne microwave and gamma airborne missions for algorithm development and validation.

4.1.4 Key Variables

Snow depth, density, water equivalent, land cover characteristic, and snowpack structure.

4.1.5 Principles of Operation

The snow sampler is lowered vertically into the snowpack with a steady thrust downward. A small amount of twisting aids in driving the tube and cutting thin ice layers; however, considerable force and driving of the sampler may be required to penetrate hard layers of ground ice. Penetration to extract a soil plug helps to prevent the loss of the snow core from the tube; a trace of soil or litter in the cutter indicates that no loss has occurred. Observation of the length of the snow core permits a quick assessment of whether a complete core is obtained; the depth of snow is measured when the sampler is inserted in the snowpack. The sample is weighed in the tube and the combined weight (in water equivalent units) is read directly with the spring balance. The tare weight of the tube is subtracted to obtain the SWE. The density of the snow is determined by dividing the water equivalent by the depth of the snow. A graduated meter stick is used in obtaining ancillary snow depth measurements.

More detailed information on suggested snow survey procedures is available in Snow Survey and Water Supply Forecasting (U.S. Soil Conservation Service, 1972), Snow Surveying (Atmospheric Environment Service, 1973), and Guide to Hydrological Practices (World Meteorological Organization, 1974).

4.1.6 Sensor/Instrument Measurement Geometry

The ESC snow sampler extracts a snow core with a surface area of 30 cm^2.

4.1.7 Manufacturer of Sensor/Instrument

The ESC-30 snow sampler and spring balance are manufactured and calibrated according to AES specifications. The ESC-30 snow sampler was made under contract for AES. There are no commercial manufacturers of this instrument. Please see specifications on how to make the snow tube in Farnes et al., 1982.

4.2 Calibration

The spring balance is used to weigh snow samples. The balance is held in a free position, and the snow sampler tube containing the snow sample is suspended from the balance in a special cradle. The inner and outer tubes of the balance are made of anodized aluminum. The anchorages for the spring in the outer and inner tubes are designed to permit free, unrestricted flexing of the spring over its entire effective length. The balance has a ring at the top for hanging the balance and a hook at the other end from which the snow sampler cradle is hung. The inner tube has a scale engraved into it, which reads from 0 at the bottom to 125 at the top. The scale indicates the SWE in centimeters.

4.2.1 Specifications

Calibration is performed by the manufacturer using a set of known weights to adjust the magnification of the spring. For more information, see AES Spring Balance Calibration Procedure, February 1987, issue 2.

4.2.1.1 Tolerance

A balance must read within ±0.3 cm of the actual weight at all levels up to 60.5 cm and ±0.4 cm at levels above 60.5 cm.

4.2.2 Frequency of Calibration

Spring balances are checked annually before snow surveys begin. A pail and water (1 liter) can be used to check the accuracy of the balance. First, use a pail of water to register a positive reading on the balance, then add 1 liter of water to the pail. The difference between the two scale readings should equal 37.8 ±0.3 cm.

4.2.3 Other Calibration Information

The spring balance should be checked from time to time during the season. Consistent repeat readings (i.e., tare) should be observed, with no indication of appreciable sticking of the spring in the balance. This ensures that the balance is not giving a false reading because the spring is not moving freely.

5. Data Acquisition Methods

Procedures similar to those described in the data set identified as Standard Snow Surveys were used. However, 3 SWE and 15 additional depth measurements had to be made at each sampling location. The individual sampling points were randomly selected (not predetermined) and were marked with a T-bar fence post.

6. Observations

6.1 Data Notes

Observations include detailed snowpack statigraphy, including ground, snow, snow surface temperatures, and snow grain type and size.

6.2 Field Notes

Copies of field notes are available from the primary contact.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

These data were collected at the two BOREAS study areas in coordination with aircraft measurements made by the BOREAS HYD-06 team.. The two study areas are located within a large area of interest covering over a million square kilometers in the Canadian Provinces of Saskatchewan and Manitoba. Each of the study areas is approximately 50 by 100 km.

The HYD-06 aircraft flew at an altitude of 150 m AGL and measured natural terrestrial gamma radiation, on average, over an average path 10.7 km long and 305 m wide, or an areal extent of 3.3 km^2. Water content was collected at various points along the flight. The number and timing of the flight lines flown each day were determined by the need for ground calibration and on the basis of need for other studies (priority was given where possible to obtaining measurements over flight lines associated with ground tower sites) and the amount of flight hours remaining for the aircraft before required maintenance. These measurements were made within the NSA and SSA and along a transect that is between these two study areas. There is a reference file associated with the HYD-06 data that contains information about the location of the various flight lines.

NSA Spatial Coverage (NAD83)

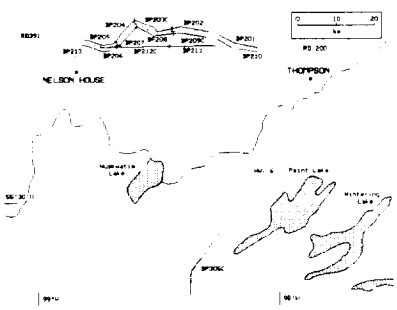
	Longitude	Latitude
Northwest	98.82°W	56.247°N
Northeast	97.24°W	56.081°N
Southeast	97.49°W	55.377°N
Southwest	99.05°W	55.54°N

SSA Spatial Coverage

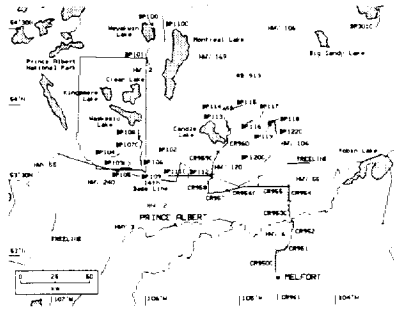
	Longitude	Latitude
Northwest	106.23°W	54.319°N
Northeast	104.24°W	54.223°N
Southeast	104.37°W	53.419°N
Southwest	106.32°W	53.513°N

7.1.2 Spatial Coverage Map

Maps of the study sites are given in the following diagrams.



Map of the NSA showing the northern study sites.



Map of the SSA showing the southern study sites.

7.1.3 Spatial Resolution

These data are point source measurements at the locations indicated.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

These data were collected from 03-Feb-1994 to 10-Mar-1994.

7.2.2 Temporal Coverage Map

The list of sites and dates when the data were collected is too long to list here. Most measurements took place between 04-Feb-1994 and 11-Feb-1994. Data for flight line BP212 was collected on 10-Mar-1994.

7.2.3 Temporal Resolution

Data were collected at a single point in time for the various sites.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name
HYD06_SITE_ID
DATE_OBS
HYD06_FLIGHT_LINE
HYD06_BIN
BIN_LATITUDE
BIN_LONGITUDE
SWE_NUM_OBS
MEAN_SNOW_DENSITY_HYD04
MEAN_SWE
SDEV_SWE
SNOW_DEPTH_NUM_OBS
MEAN_SNOW_DEPTH
SDEV_SNOW_DEPTH
COVER_TYPE
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
HYD06_SITE_ID	The identifier assigned to the site by BOREAS, in the format AAA-FFF-GGGGG-SMAC01 where AAA is the study area, FFF is the flight line number, GGGGG is the science group, and SMAC01 stands for Soil Moisture Aircraft.
DATE_OBS	The date on which the data were collected.
HYD06_FLIGHT_LINE	The HYD-06 designation for the line/transect over which the aircraft flew.
HYD06_BIN	The HYD-06 designation for the part of the flight line over which the soil moisture measurement was derived.
BIN_LATITUDE	Approximate latitude of mid-point of calibration line or bin.
BIN_LONGITUDE	Approximate longitude of mid-point of calibration line or bin.
SWE_NUM_OBS	Number of snow water equivalent (SWE) measurements taken.
MEAN_SNOW_DENSITY_HYD04	The mean snow density calculated from the mean SWE divided by the mean of the measured core depths.
MEAN_SWE	The mean snow water equivalent (SWE) calculated from the mean snow depth times the mean snow density.
SDEV_SWE	Standard deviation of snow water equivalent (SWE) measurements.
SNOW_DEPTH_NUM_OBS	Number of extra snow depth measurements taken.
MEAN_SNOW_DEPTH	The mean depth of snow.

SDEV_SNOW_DEPTH	Standard deviation of extra snow depths.
COVER_TYPE	The dominant species, vegetation or type of land cover that exists at the location.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
HYD06_SITE_ID	[none]
DATE_OBS	[DD-MON-YY]
HYD06_FLIGHT_LINE	[none]
HYD06_BIN	[none]
BIN_LATITUDE	[degrees]
BIN_LONGITUDE	[degrees]
SWE_NUM_OBS	[counts]
MEAN_SNOW_DENSITY_HYD04	[kilograms][meter^-3]
MEAN_SWE	[millimeters]
SDEV_SWE	[millimeters]
SNOW_DEPTH_NUM_OBS	[counts]
MEAN_SNOW_DEPTH	[millimeters]
SDEV_SNOW_DEPTH	[millimeters]
COVER_TYPE	[none]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
HYD06_SITE_ID	[Supplied by Investigator]
DATE_OBS	[Supplied by Investigator]
HYD06_FLIGHT_LINE	[Supplied by Investigator]
HYD06_BIN	[Supplied by Investigator]
BIN_LATITUDE	[Supplied by Investigator]
BIN_LONGITUDE	[Supplied by Investigator]
SWE_NUM_OBS	[Supplied by Investigator]
MEAN_SNOW_DENSITY_HYD04	[Supplied by Investigator]
MEAN_SWE	[Supplied by Investigator]
SDEV_SWE	[Supplied by Investigator]
SNOW_DEPTH_NUM_OBS	[Supplied by Investigator]
MEAN_SNOW_DEPTH	[Supplied by Investigator]
SDEV_SNOW_DEPTH	[Supplied by Investigator]
COVER_TYPE	[Supplied by Investigator]
CRTFCN_CODE	[Assigned by BORIS]
REVISION_DATE	[Assigned by BORIS]

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
HYD06_SITE_ID	N/A	N/A	None	None	None	None
DATE_OBS	03-FEB-94	10-MAR-94	None	None	None	None
HYD06_FLIGHT_LINE	BP103	CR959	None	None	None	None
HYD06_BIN	1	S	None	None	None	None
BIN_LATITUDE	49.596	55.929	None	None	None	None
BIN_LONGITUDE	-107.2165	-98.2637	None	None	None	None
SWE_NUM_OBS	0	57	None	None	None	None
MEAN_SNOW_DENSITY_HYD04	115	256	-999	None	None	None
MEAN_SWE	31	73	-999	None	None	None
SDEV_SWE	2	39	-999	None	None	None
SNOW_DEPTH_NUM_OBS	0	285	None	None	None	None
MEAN_SNOW_DEPTH	153	500	-999	None	None	None
SDEV_SNOW_DEPTH	26	122	-999	None	None	None
COVER_TYPE	N/A	N/A	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	06-JUN-97	06-JUN-97	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.
Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A -- Indicates that the value is not applicable to the respective column.
None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following are wrapped versions of data records from a sample data file on the CD-ROM.

```
DATE_OBS,HYD06_SITE_ID,HYD06_FLIGHT_LINE,HYD06_BIN,BIN_LATITUDE,BIN_LONGITUDE,
SWE_NUM_OBS,MEAN_SNOW_DENSITY_HYD04,MEAN_SWE,SDEV_SWE,SNOW_DEPTH_NUM_OBS,
MEAN_SNOW_DEPTH,SDEV_SNOW_DEPTH,COVER_TYPE,CRTFCN_CODE,REVISION_DATE
03-FEB-94,'CAN-603-HYD06-SMAC01','CR603','S',49.596,-104.62,20,238.0,61.0,39.0,
100,258.0,122,'agricultural','CPI',06-JUN-97
04-FEB-94,'REG-801-HYD06-SMAC01','CR801','S',51.0268,-104.48,19,256.0,53.0,30.0,
95,205.0,111,'agricultural','CPI',06-JUN-97
05-FEB-94,'REG-805-HYD06-SMAC01','CR805','S',52.2718,-104.5032,57,219.0,44.0,
15.0,285,199.0,104,'agricultural','CPI',06-JUN-97
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data from a given site on a given date.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

density = (swe/(depth*10))*1000

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables
None.

9.4 Graphs and Plots
None.

10. Errors

10.1 Sources of Error
Errors in the data collected by the snow survey teams may arise from several sources:
- Warm temperatures, which can cause snow to stick in the tube.
- Changes to scale precision caused by air temperature fluctuations.
- Scale readings by different observers or during windy conditions, which can yield erratic scale readings.

10.2 Quality Assessment
The quality of the data collected by the survey teams is thought to range from good to excellent; generally it is considered to be excellent. Generally, data quality is potentially lowest when the snowpack is shallowest. No formal quality assurance is done; however, a coarse check was made after the completion of the survey.

10.2.1 Data Validation by Source
The data were spot checked by BORIS to make sure that no conversion errors occurred during loading.

10.2.2 Confidence Level/Accuracy Judgment
This data set represents the best estimate of snow depth and SWE by land cover/vegetation type for the immediate vicinity of the snow course on the date of the survey. Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

10.2.3 Measurement Error for Parameters
Given by standard error for SWE and depth.

10.2.4 Additional Quality Assessments
None.

10.2.5 Data Verification by Data Center
The data set was reviewed to ensure that it represents the data that are described.

11. Notes

11.1 Limitations of the Data
This data set represents the best estimate of snow depth and SWE by land cover/vegetation type for the immediate vicinity of the snow course on the date of the survey. Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

11.4 Other Relevant Information

None.

12. Application of the Data Set

This data set can be used to develop and validate snow cover algorithms from airborne passive microwave measurements or other remote sensing techniques where SWE can be estimated.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

None.

14.2 Software Access

None.

15. Data Access

The HYD-04 areal snow course data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Atmospheric Environment Service. 1973. Snow surveying. 2nd Ed. Environ. Can., Downsview. Ont.

Farnes, P.E., N.R. Peterson, B.E. Goodison, and R.P. Richards. 1982. Metrication of Manual Snow Sampling Equipment by Western Snow Conference Metrication Committee. 39th Annual Proceedings of the Eastern Snow Conference, Reno, NV, Apr. 19-23, 1982, pp. 120-132.

Goodison, B.E., J.E. Glynn, K.D. Harvey, and J.E. Slater. 1987. Snow Surveying in Canada: A Perspective. Can. Wat. Res. Jr., Vol. 12, 2, pp. 27-42.

U.S. Soil Conservation Service. 1972. Snow survey and water supply forecasting. Section 22, SCS Nat. Eng. Handb., U.S. Dept. Agric., Washington, DC.

World Meteorological Organization. 1974. Guide to hydrological practices. 3rd Ed. Ch. 2, Instruments and Methods of Observation. WMO No.168, World Meteorological Organization, Geneva, pp. 2.1-2.90.

17.2 Journal Articles and Study Reports

Goita, K., A.E. Walker, B.E. Goodison, and A.T.C. Chang. 1997. Estimation of snow water equivalent in the boreal forest using passive microwave data. Proc. (CD-ROM) GER'97 (Geomatics in the Era of Radarsat). Ottawa, Canada, May 25-30, 1997.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

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AES      - Atmospheric Environment Service
ASCII    - American Standard Code for Information Interchange
BOREAS   - BOReal Ecosystem-Atmosphere Study
BORIS    - BOREAS Information System
CD-ROM   - Compact Disk-Read-Only Memory
CGR      - Certified by Group
CPI      - Certified by Principal Investigator
CPI-???  - CPI but questionable
DAAC     - Distributed Active Archive Center
EOS      - Earth Observing System
EOSDIS   - EOS Data and Information System
ESC      - Eastern Snow Conference
FFC-W    - Focused Field Campaign - Winter
GIS      - Geographic Information System
GPS      - Global Positioning System
GSFC     - Goddard Space Flight Center
HTML     - HyperText Markup Language
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HYD     - Hydrology
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
PI      - Principal Investigator
PRE     - Preliminary
SSA     - Southern Study Area
SWE     - Snow Water Equivalent
URL     - Uniform Resource Locator
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20. Document Information

20.1 Document Revision Date

Written: 01-May-1995
Last Revised: 22-Jul-1999

20.2 Document Review Date

BORIS Review: 26-Feb-1998
Science Review: 13-Jan-1998

20.3 Document ID

20.4 Citation

When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

The areal snow survey data were collected by personnel with the Climate Research Branch, AES, with assistance from personnel from the University of Waterloo, Dept. of Civil Engineering, NASA GSFC, and the Norwegian Institute of Technology.

If using data from the BOREAS CD-ROM series, also reference the data as:

Goodison, B. and A. Walker, "Determination of Snow Cover Variations in the Boreal Forest Using Passive Microwave Radiometry." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	July 2000	Technical Memorandum

4. TITLE AND SUBTITLE
Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)
BOREAS HYD-4 Areal Snow Course Data

5. FUNDING NUMBERS
923
RTOP: 923-462-33-01

6. AUTHOR(S)
John R. Metcalfe, Barry E. Goodison, and Anne Walker
Forrest G. Hall and David E. Knapp, Editors

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES)
Goddard Space Flight Center
Greenbelt, Maryland 20771

8. PEFORMING ORGANIZATION REPORT NUMBER
2000-03136-0

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
TM—2000–209891
Vol. 26

11. SUPPLEMENTARY NOTES
J.R. Metcalfe, B.E. Goodison, A. Walker: Atmospheric Environment Service, Canada;
D.E. Knapp: Raytheon ITSS

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unclassified–Unlimited
Subject Category: 43
Report available from the NASA Center for AeroSpace Information,
7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS HYD-4 team focused on collecting data during the 1994 winter field campaign (FFC-W) to improve the understanding of winter processes within the boreal forest. Knowledge of snow cover and its variability in the boreal forest is fundamental if BOREAS is to achieve its goals of understanding the processes and states involved in the exchange of energy and water. The development and validation of remote sensing algorithms will provide the means to extend the knowledge of these processes and states from the local to the regional scale. A specific thrust of the hydrology research is the development and validation of snow cover algorithms from airborne passive microwave measurements. Airborne remote sensing data (gamma, passive microwave) were acquired along a series of flight lines established in the vicinity of the BOREAS study areas. Ground snow surveys were conducted along selected sections of these aircraft flight lines. These calibration segments were typically 10-20 km in length, and ground data were collected at 1- to 2-km intervals. The data are provided in tabular ASCII files.

14. SUBJECT TERMS	15. NUMBER OF PAGES
BOREAS, hydrology, remote sensing.	16
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL